

MODIS/Snow Project
Quarterly Report (3 April 1992)
Time Period: January - March 1992
Submitted by D. K. Hall/code 974

Data Analysis

Analysis continued on ASAS and TM data collected in March 1991 at Glacier National Park, MT. Data beyond ASAS band 23 were determined to be unusable due to lack of sensitivity in this wavelength region, to a bright target. Radiance curves for a variety of snow covered sites have been studied: a frozen lake with pure snow on top, a snow covered meadow, a mixed deciduous/coniferous forest and a dense coniferous, snow covered forest. Results show that the influence of the snow on the dense, coniferous forest is not apparent, but that both forward and backscattering is evident in the mixed deciduous/coniferous forest indicating that the bidirectional radiances of both snow and trees are evident in some snow covered forests. Attempts to calculate snow reflectance from ASAS radiances have not yet been successful. Discussions have been held with Jim Irons of the Biospheric Sciences Branch. The complexity of this problem may be greater than previously considered and this problem is being studied.

An algorithm for the identification of snow cover using MODIS-N data is being developed. The snow cover algorithm currently employs a series of criteria tests and a normalized snow difference index that identifies snow by its reflectance characteristics in the visible and near-infrared regions, and also discriminates between snow and many types of clouds. Several Landsat TM scenes have been used to develop imagery that simulates the MODIS resolution. Algorithms are being applied to these data to test the ability of the algorithms to map snow and discriminate snow and clouds and to discriminate sunlit and shaded snow.

Field Work in Glacier National Park, Montana

During the week of 23-27 February, D. Hall, J. Foster and A. Chang of the Hydrological Sciences Branch conducted field work in Glacier National Park, Montana. The NASA C-130 aircraft with the Advanced Solid-State Spectroradiometer (ASAS) and the NS-001 sensors on board overflew the sites on 25 and 26 February. Measurements of atmospheric optical thickness and total incoming solar radiation, were made simultaneous with the overflights. In-situ snow measurements included snow depth, temperature and crystal size.

During the field study period, the snow was ablating rapidly due to unusually warm air temperatures. On 25 February on the eastern side of the Park, ASAS targets consisted of

patchy snow in a meadow site, and bare lake ice over St. Mary Lake. In-situ spectrometer measurements were acquired simultaneous with the aircraft overflight. Similar in situ and ASAS measurements were made at the second site on 26 February on the western side of the park where the snow was deeper and more continuous than it was on the eastern side of the Park.

The field program at Glacier National Park was a collaborative effort among several groups: the Hydrological Sciences Branch, the Biospheric Sciences Branch (J. Irons and B. Holben), the Sensors Concept and Development Branch (P. Dabney) and U.S. Park Service/Glacier National Park, MT scientists. The C-130 crew, headed by Chris Scofield, provided excellent aircraft support.

Modis Airborne Simulator Flights

On 7 February 1992, D. Hall and J. Ormsby (Code 974) met with M. King/913, K. Brown/975, and several contractors to discuss the MODIS simulator (MAS) data that were acquired over snow covered targets near the Sierra Nevada Mts. and Lake Tahoe, California in October and November 1991. Preliminary studies indicate that the quality of the MAS snow data is good in most bands.

D. Hall and Jim Ormsby of the Hydrological Sciences Branch have been attempting to transfer MAS data over to the Hydrological Sciences Branch Silicon Graphics system. This is necessary in order to analyze the two snow data sets that resulted from overflights of the ER-2 last fall. Hall and Ormsby took a course to learn the EASI PACE software and a preliminary analysis of the MAS data has begun.

BOREAS Participation

The MODIS/snow project input to the BOREAS land group proposal was completed and sent to Steve Running/University of Montana. We did not ask for additional funding because our projected FY93 and 94 funding should be adequate for our BOREAS participation. If our MODIS/snow budget is reduced, we may not be able to participate in BOREAS at the level that we have proposed.

Conference/Seminars

D. Hall gave a seminar at Glacier National Park on 27 February. The content of the seminar dealt with snow reflectance and the MODIS project and field work.

On March 29-31, D. Hall attended the Snow Watch '92 Workshop which was held in Niagara-on-the-Lake, Ontario, Canada. Hall

presented a paper on lake ice as an indicator of regional climate change. There was considerable discussion at the meeting about snow as an indicator of climate change, the future of snow mapping, and the utility of the current NOAA snow maps. A proceedings volume is in preparation.

Papers:

An abstract was submitted to the Eastern Snow Conference entitled "Analysis of Satellite and Aircraft Data for mapping Snow Cover and Reflectance," by D.K. Hall and J.P. Ormsby. Preliminary results obtained using MAS and previous work using other aircraft and satellite (TM) data will be presented, and a paper will be written for inclusion in the Proceedings. The conference will be held on 3-4 June 1992 in Oswego, NY.

The paper entitled "Airborne bidirectional radiance measurements over northern Montana, U.S.A.," by D.K. Hall, J.L. Foster, J.R. Irons and P. Dabney, was completed. This paper discusses preliminary results from the ASAS data acquired over Glacier National Park, Montana in March 1991. The paper will be published in the International Glaciological Society's Annals of Glaciology, following peer review, and will be presented at the International Symposium on Remote Sensing in Glaciology to be held 17-22 May 1992 in Boulder, Co.

An abstract was submitted to the ASPRS/ACSM/RT 92 Convention which will be held in Washington, D.C. in August 1992. The title of the proposed paper is "Evolution of a Snow Cover Algorithm for the Moderate Resolution Imaging Spectrometer-Nadir (MODIS-N)." The authors are G. Riggs, D. Hall, J. Barker and V. Salomonson. The paper, which is due in final form by May 15, 1992, will present preliminary results of the MODIS snow/cloud discrimination algorithm development.